the elastic adhesive to be applied is from 0.01g/cm² to 0.05g/cm².

11.(amended) The airbag as claimed in claim 1, wherein the elastic adhesive is room temperature vulcanizing silicone rubber.

14.(amended) The airbag as claimed in claim 1, wherein said adhesive is adhered not only to the peripheral portions of the panels where they are sewn each other but also to a neighborhood thereof inside the airbag, so that the elastic adhesive in the neighborhood peels and absorbs stress applied thereto when the airbag is inflated.

REMARKS

The specification has been reviewed, and clerical errors of the specification have been amended.

In the Office Action Summary, it was held that none of the certified copies of the priority documents has been received. However, the priority documents were filed in the parent applications. Therefore, please confirm receipt of the priority documents.

In paragraph 2 of the Action, the disclosure was objected to. In view of the objection, the disclosure has been amended.

In paragraph 4 of the Action, claim 11 was rejected under 35 U.S.C. 112, second paragraph. In paragraph 6 of the Action, claims 1-4, 7-13, 15 and 16 were rejected under 35 U.S.C. 103(a) as being unpatentable over Saderholm et al. in view of Hirai. In paragraph 7 of the Action, claims 5, 6 and 14 were rejected under 35 U.S.C. 103(a) as being unpatentable over Saderholm et al. in view of Hirai and Gray et al.

In view of the rejections, claims 1, 7-11 and 14 have been amended. Therefore, the application is patentable over the cited references.

As clearly recited in amended claim 1, an airbag of the invention is formed of a first panel and a second panel, which have peripheral portions having inner surfaces facing and connected to each other. Elastic adhesive is disposed between the inner surfaces of the first and second panels at the peripheral portions to connect the first and

second panels, and a yarn is sewed along the peripheral portions within a range of the width of the elastic adhesive to connect the first and second panels together with the elastic adhesive. Therefore, when the first and second panels are pulled in inflating the airbag, the adhesive is pulled outwardly to absorb an expansion force.

In the invention, the outer peripheral portions are connected by the elastic adhesive at the inner surfaces thereof, and the yarn sewed within the range of the width of the elastic adhesive. Therefore, when the airbag is inflated, the elastic adhesive is elastically pulled outwardly. Thus, the expansion force of the airbag is absorbed properly, and the first and second panels are securely connected without gas leakage.

In Saderholm et al., an airbag is formed of three panels 10, 11, 12 firmly connected together along the peripheries. The inner panel 11 has an opening 16 and vents 26, and is connected to the upper panel 10 at a seam 23 and to the lower panel 12 at a seam 21. When the airbag is inflated, at first, the upper and inner panels 10, 11 are expanded outwardly, and after the seam 23 is broken, the upper panel 10 is expanded further.

In the invention, the elastic adhesive is disposed between the inner surfaces of the first and second panels at the peripheral portions to connect the first and second panels. In Saderholm et al., although the outer peripheries of the panels 10-12 are sewed together, no adhesive is provided between inner surfaces of the panels.

In the invention, the yarn is sewed along the peripheral portions, but the yarn or sewed portion is located within a range of the width of the elastic adhesive to connect the first and second panels together with the elastic adhesive. In Saderholm et al., although the panels are sewed together, the sewing is not made inside the elastic adhesive because there is no elastic adhesive.

In the invention, when the first and second panels are pulled in inflating the airbag, the adhesive is pulled outwardly to absorb an expansion force of the airbag. In Saderholm et al., since the adhesive is not deposited between the panels, the outer seam 17 is directly pulled outwardly without elastic absorption.

Saderholm et al. does not disclose or suggest the features of the invention.

In Hirai, a resin airbag is formed of front and rear panels 2, 3 with different sizes, and adhesive resin 5 for connecting the front and rear panels 2, 3. The adhesive resin 5 is deposited at end face 2s, an inner surface 2i, an end face 3s and an outer surface 3a to connect the two panels 2, 3 (column 2, lines 8-13).

In the invention, the elastic adhesive is disposed between the inner surfaces of the first and second panels at the peripheral portions to connect the first and second panels. In Hirai, although the adhesive resin 5 is used to connect the two panels, the adhesive resin 5 is not deposited between the inner surfaces of the two panels, as defined in claim 1.

In the invention, therefore, when the first and second panels are pulled in inflating the airbag, the adhesive is pulled outwardly to absorb an expansion force of the airbag. In Hirai, since the adhesive is not deposited between the panels, the adhesive does not operate to absorb the expansion force when the airbag is inflated.

In the invention, the yarn is sewed along the peripheral portions within the range of the width of the elastic adhesive to connect the first and second panels together with the elastic adhesive. In Hirai, the panels are not sewed together at the peripheries of the panels.

Hirai does not disclose or suggest the features of the invention.

In Gray et al., a flexible polymerized resin 16 is partly applied to a front panel 8. However, in Gray et al., there is no adhesive nor yarn, as defined in the invention.

As explained above, the cited references do not disclose or suggest the features of the invention. In case Saderholm et al. and Hirai are combined, the adhesive as disclosed in Hirai may be applied to the outer peripheries of the panels as disclosed in Saderholm et al. However, since the adhesive is not formed between the inner surfaces of the two panels, the combination of the cited references does not constitute or disclose the present invention. Even if the cited references are combined, the present invention is not obvious from the cited references.

Reconsideration and allowance are earnestly solicited.

Respectfully submitted,

KANESAKA AND TAKEUCHI

by 

Manabu Kanesaka
Reg. No. 31,467
Agent for Applicants

1423 Powhatan Street
Alexandria, VA 22314
(703) 519-9785

Serial No. 09/644,793

1.(amended) An airbag comprising:

a first panel and a second panel, which have peripheral portions [of which are] having inner surfaces facing and connected to each other [by connecting means],

[wherein said connecting means includes sewing by yarn and bonding by] elastic adhesive disposed between the inner surfaces of the first and second panels at the peripheral portions to connect the first and second panels, and

a yarn sewed along the peripheral portions within a range of the width of the elastic adhesive to connect the first and second panels together with the elastic adhesive so that when the first and second panels are pulled in inflating the airbag, the adhesive is pulled outwardly to absorb an expansion force.

7.(amended) The airbag as claimed in claim 1, wherein said [sewing by] yarn comprises a first seam positioned outside and a second seam positioned inside relative to a center of the first and second panels, [and wherein the] a sewing yarn for the second seam [is] being thinner than [the] a sewing yarn for the first seam.

8.(amended) The airbag as claimed in claim 7, wherein the sewing yarn for the second seam is broken during [the] inflation of the airbag so as to partially absorb energy of gas pressure.

9.(amended) The airbag as claimed in claim 1, [wherein the seam] further comprising sealant to cover the yarn on the peripheral portions of the panels [is covered by sealant].

10.(amended) The airbag as claimed in claim 1, wherein [the] an amount of the elastic adhesive to be applied is from 0.01g/cm^2 to 0.05g/cm^2.

11.(amended) The airbag as claimed in claim 1, wherein the elastic adhesive is [RTV (] room temperature vulcanizing [)] silicone rubber.

14.(amended) The airbag as claimed in claim 1, wherein said adhesive is adhered not only to the peripheral portions of the panels where they are sewn each other but also to [the] a neighborhood thereof inside [in] the airbag, so that the elastic adhesive in the neighborhood peels and absorbs stress applied thereto when the airbag is inflated.

TITLE OF THE INVENTION

AIRBAG

CROSS REFERENCE TO RELATED APPLICATION

Cross reference to related application

This is a continuation-in-part application of patent applications Serial No.09/318,251 filed on May 25,1999, abandoned and Serial No. 09/342,171 filed on June 29, 1999 abandoned.

BACKGROUND OF THE INVENTION AND RELATED ART STATEMENT

The present invention relates to an airbag for an airbag device installed in a conveyance including a vehicle and an aircraft and, more particularly, to an airbag where gas is prevented from leaking from seams between panels.

(a) An vehicle airbag for an automobile, such as a driver's airbag, a front passenger's airbag, a rear passenger's airbag, and a side airbag, or an airbag for an aircraft, has a plurality of panels which are sewn together in a bag-like configuration. The airbag is inflated by gas supplied from an inflator.

An airbag which requires to retain its internal pressure for a long time is desired to extremely prevent gas leakage through seams. Such an airbag is for example a side airbag (of a curtain type) for protecting a head of an occupant and a side airbag for coping with roll over.

In order to prevent the gas leakage through the seams between the panels, as shown in Figs. 4a, 4b, silicone tapes 4 are attached along

peripheries of panels 1', 2' to cover a seam 3' of the panels 1', 2'.

In the conventional airbag in Figs. 4a, 4b, the silicone tapes 4 must be attached to the both surfaces of the airbag, thereby increasing the labor man-hour and impairing the productivity. When high pressure gas is introduced into the airbag, there is a possibility of gas leakage through a clearance between the panels 1', 2' as shown in an arrow G in Fig. 4b. Therefore, the amount of gas to be supplied by the inflator must be increased in consideration of the amount of gas leakage, so the capacity of the inflator should be large.

OBJECT AND SUMMARY OF THE INVENTION

An object of the present invention is to provide an airbag where gas is prevented from leaking at seams between panels and which has excellent productivity.

An airbag of the present invention has a first panel and a second panel, peripheral portions of which are connected to each other by sewing by yarn and bonding by elastic adhesive.

The elastic adhesive has preferably elongation of more than 200%, more preferably of 200 to 1000%. The elastic adhesive may be one of silicone adhesive, urethane adhesive, nitrile rubber adhesive, and polysulfide adhesive. Silicone RTV (room temperature vulcanizing) adhesive is preferable as the silicone adhesive.

If the panel is coated with a silicone coating for prevention of gas leakage through the panel, the elastic adhesive is preferably silicone adhesive. If the panel is coated with an urethane coating, the elastic

stretches according to the stress.

The elastic adhesive may be adhered not only to the peripheral portions of the panels where they are sewn each other but also to the neighborhood thereof inside in the airbag , so that the elastic adhesive in the neighborhood peels and absorbs stress applied thereto when the airbag is inflated.

The elastic adhesive is preferable to be as flexible as possible so that the airbag becomes easy to be folded with a small bending resistance of the airbag whereby reducing a packaging volume of the airbag.

The elastic adhesive adhered to the airbag is preferable to be hardened rapidly in any oven with a short time. The elastic adhesive is preferably of one-can type in this case.

The elastic adhesive may be partially applied to the airbag, and each portion of the elastic adhesive may have a configuration like a column or a corn. The column or the corn of the elastic adhesive prevents air from remaining in the hardened elastic adhesive which bonds the panels.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1a is a perspective view showing an embodiment of an airbag according to the present invention, Fig. 1b is an enlarged sectional view taken along a line IB-IB of Fig. 1a, Fig. 1c is an enlarged sectional view of a part of the peripheries of the airbag when inflated;

Fig. 2 is an enlarged sectional view of the part of the peripheries of the airbag when fully inflated;

the inner stitching line is broken by the pressure of gas supplied from an inflator, thereby partially absorbing the energy of the gas pressure which is exerted on a connection of the panels 1, 2 in the stripping direction. Therefore, the impact exerted in such a direction as to break the first seam composed of the sewing yarn 6B can be reduced, thereby further securely preventing the gas leakage at the connection of the panels 1, 2.

The relatively thin sewing yarn 6A composing the inner stitching line preferably has fineness about 210-420d (deniers) and the relatively thick sewing yarn 6B composing the outer stitching line preferably has finesses about 840-1260d. The first seam by the sewing yarn 6B is preferably located apart from the peripheral edges of the panels 1, 2 by a distance about 10-18 mm and the distance (d in Fig. 1b) between the yarn 6B and the yarn 6A is preferably about 2-5 mm.

The airbag 10 can be made by superposing the panels 1, 2 having a portion to be sewn to which the elastic adhesive 5 is applied and, after that, sewing up them with the sewing yarns 6A, 6B. Since the panels 1, 2 are bonded to each other by the elastic adhesive 5, the panels 1, 2 are prevented from slipping to each other during the sewing, thereby improving the sewing workability.

Though the two sewing yarns are used to stitch the double seams in the airbag shown in Figs. 1a, 1b, 1c, the sewing may be made by using only one sewing yarn. In this case, a sewing yarn having fineness about 840-1260d is preferably used and a portion along and apart from the peripheral edges of the panels by a distance 10-20 mm is preferably stitched.

yarns composing the outer stitching line.

At the middle portions of the panels 21, 22, as shown in Fig. 7b, the panes 21, 22 are bonded with the elastic adhesive 26 and sewn up by the sewing yarn 24 to each other. The sewing yarn 24 comprises a thin yarn 24A and a thick yarn 24B. The yarn 24A is positioned close to an inner chamber 28 of the airbag 20 as compared to the yarn 24B. Therefore, during the inflation of the airbag 20, the thin yarn 24A is broken in the same manner as the case of Fig. 2, thereby partially absorbing the energy applied to the connection of the panels 21, 22 in the stripping direction. As a result of this, the impact in the stripping direction applied to the seam made by the sewing yarn 24B is reduced.

Though the two sewing yarns 24A, 24B having different thickness are used in the embodiment of Figs. 5-7, only one stitching line may be provided.

As mentioned above, the present invention provides an airbag which can securely prevent the gas leakage from the connection between the panels and has excellent productivity.

The specification refers to the disclosure of applications Serial No. 09/318,251 filed on May 25, 1999 and Serial No. 09/342,171 filed on June 29, 1999 is herein incorporated.